V. REMARKS

Claims 1-8 (presumptively claims 1, 3, 5, 7 and 8 because claims 2, 4 and 6 have been canceled) are rejected under 35 U.S.C. 103(a) as unpatentable over Hermann (U.S. Patent No. 3,839,209) in view of United Lab Equipment, Inc. and Wikipedia. Claims 9 and 11-16 are rejected under 35 U.S.C. 103(a) as unpatentable over Hermann in view of United Lab Equipment, Inc., Wikipedia and Shimotomai (U.S. Patent No. 5,868,555). The rejections are respectfully traversed.

Hermann discloses an organometallic reticulated anti-friction composition obtained from at least one solid epoxy resin containing terminal epoxy groups, lead powder, bismuth powder, mixtures thereof and alloys comprising lead, bismuth, lead and bismuth, and mixtures thereof (see claim 1). The alloy may be selected from at least one member of the group consisting of Pb-Bi, Pb-Sn, Bi-Sn, Pb-Bi-Sn, Pb-Sn-Sb, Pb-Sn-Pb-Cu, Pb-Sn-Cu-Cd or Pb-Sn-Sb-Cu-Ni (see claim 7), a solid lubricant may be contained in the composition (see claim 8).

As described above, Hermann discloses alloys containing copper such as Pb-Sn-Sb-Cu so that the Examiner seems on the opinion that the alloys disclosed in Hermann overlap the present invention.

The present invention relates to a sliding member provided with a sliding layer containing bismuth powder and/or bismuth alloy powder, metal powder, and a solid lubricant. The metal powder contains at least one of a copper-based alloy and aluminum-based alloy.

As specified by the above amendment, the bismuth powder and/or bismuth alloy powder, and the metal powder are mixed with the thermosetting resin in the sliding layer. By adopting such constitution, the thermal conductivity in the sliding layer is improved, and hence, heat does not accumulate in the sliding layer portion, by which seizure can be prevented as described in the specification, paragraph 0043.

As described in Whikipedia "Bismuth" cited in the last official action, bismuth has the second lowest thermal conductivity. Thus, bismuth 1 is poor in effect on prevention of seizure. For this reason, the present invention uses the metal powder containing a copper-based alloy or aluminum based alloy, which is excellent in thermal conductivity to prevent heat from accumulating in the sliding layer.

Applicants enclose herewith a Wikipedia "List of thermal conductivities", which shows that cooper, copper alloys and aluminum are superior to bismuth in thermal conductivity.

Hermann does not disclose or suggest that a copper-based alloy powder or aluminum-based alloy powder, superior in thermal conductivity, is mixed with a thermosetting resin to prevent heat accumulation in a sliding layer as in the present invention.

Accordingly, the invention of present claim 1 is patentable over the prior art references so that the claims dependent upon claim 1 are also patentable thereover. Therefore, the outstanding rejections should be withdrawn and the present application should be allowed.

Withdrawal of the rejections is respectfully requested.

Further, Applicants assert that there are also reasons other than those set forth above why the pending claims are patentable. Applicants hereby reserve the right to submit those other reasons and to argue for the patentability of claims not explicitly addressed herein in future papers.

In view of the foregoing, reconsideration of the application and allowance of the pending claims are respectfully requested. Should the Examiner believe anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' representative at the telephone number listed below.

Should additional fees be necessary in connection with the filing of this paper or if a Petition for Extension of Time is required for timely acceptance of the same, the

Commissioner is hereby authorized to charge Deposit Account No. 18-0013 for any such fees and Applicant(s) hereby petition for such extension of time.

Respectfully submitted,

Date: April 16, 2007 By:

Carl Schaukowitch
Reg. No. 29,211

RADER, FISHMAN & GRAUER PLLC
1233 20th Street, N.W. Suite 501
Washington, D.C. 20036
Tel: (202) 955-3750
Fax: (202) 955-3751
Customer No. 23353

Enclosure(s): Amendment Transmittal
Wikipedia - List of thermal conductivities (pages 1-3
Wikipedia - Bismuth (pages 1-4)

DC272039.DOC

List of thermal conductivities

From Wikipedia, the free encyclopedia

In physics, **thermal conductivity**, k, is the intensive property of a material that indicates its ability to conduct heat.

It is defined as the quantity of heat, Q, transmitted in time t through a thickness L, in a direction normal to a surface of area A, due to a temperature difference ΔT, under steady state conditions and when the heat transfer is dependent only on the temperature gradient.

thermal conductivity = heat flow rate × distance / (area × temperature difference)

$$k = \frac{Q}{t} \times \frac{L}{A \times \Delta T}$$

This list makes up the data for the smaller list provided in Thermal conductivity.

Material	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	Temperature (K)	Electrical conductivity @ 293 - 273 K ($\Omega^{-1} \cdot m^{-1}$)	Notes
Diamond, purfied synthetic	[i]2,000-[i]2,500		(Lateral)[i]10^{-16} - (Ballistic)[i]10^{8+}	
Diamond, impure	[ad]1,000	[a]273	[i]~10^{-16}	(C+0.1%N) Type I (98.1% ofGem Diamonds)
Silver, pure	[d]406 - [f]418 - [agi]429	[g]273-[ai]300-[g]373	[g]61.35 - [i]63.01 - [i]68.17 × 10^6	Highest *electrical* conductivity of any metal
Copper, pure	[d]385 - [f]386 - [e]390 - [gi]401	[g]273-[ci]293-[g]373	[g]59.17 - [i]59.59 - [i]64.81 × 10^6	IACS standard pure is 1.7×10^{8} $\Omega \cdot m = 58.82\times10^{-6} \Omega^{-1} \cdot m^{-1}$
Gold, pure	[d]314 - [fgi]318	[g]273-[i]300-[g]373	[i]45.17 - [g]45.45 - [i]48.76 × 10^6	
Aluminium, pure	[d]205 - [f]220 - [egi]237	[g]273-[ci]293-[g]373	[g]37.45 - [i]37.74 - [i]41.37 × 10^6	
Brass	[dg]109 - [f]119 - [f]151 - [g]159	[g]296	[g]12.82 - [g]21.74 × 10^6	(Cu+(37-15)%Zn)
Iron, pure	[f]71.8 - [d]79.5 - [a]80.2 - [gi]80.4	[g]273-[ai]300-[g]373	[g]9.901 - [i]10.41 - [i]11.67 × 10^6	
Cast iron	[f]55			(Fe+(2-3.5)%C+(1-3)%Si)
Bronze	([f](25%Sn)26) [g]42 - [g]50	[g]296	[g]5.882 - [g]7.143 × 10^6	(Cu+11%Sn)
Carbon Steel	[f]36 - [d]50.2 - [f]54			(Fe+(1.5-0.5)%C)
Stainless Steel	[a]14 - [fg]16.3	[a]273 - [g]296	[g]1.389 - [g]1.429 × 10^6	(Fe+18%Cr+8%Ni)
Lead, pure	[d]34.7 - [f]35 - [gi]35.3	[g]273-[i]300-[g]373	[i]4.808 - [g]4.854 - [i]5.208 × 10^6	

Titanium, pure	[f]15.6 - [g][i]21.9	[g]273-[i]300-[g]373	[g]1.852 - [i]2.381 - [i]2.564 $\times 10^6$	
Titanium Alloy	[g]5.8	[g]296	[g]0.595 $\times 10^6$	(Ti+6%Al+4%V) 50+% of All Aircraft
Granite	[b]1.73 - [b]3.98			(72.04%SiO_2+14%Al_2O_3+4%K_2O etc.)
Marble	[b]2.07 - [b]2.94			Mostly $CaCO_3$
Thermal grease, silver-based	[i]2 - [i]3			
Sandstone	[b]1.83 - [b]2.90			~95-71%SiO_2
Ice	[d]1.6 - [e]2.1 - [a]2.2	[e]293 - [a]273		
Limestone	[b]1.26 - [b]1.33			Mostly $CaCO_3$
Concrete	[d]0.8 - [e]1.28	[e]293		~61-67%CaO
Glass	[d]0.8–[e]0.93([g](96% SiO_2)1.2-1.4)	[e(g)]293	10^{-14} - [(g)]10^{-12} - 10^{-10}	<1% Iron oxides
Fibre-reinforced plastics	[g]0.23 - [g]0.7 - [e]1.06	[g]296 - [e]293	[g]10^{-15} - [g]10^{0}	10-40%GF or CF
Soil	[c]0.17 - [c]1.13			
Water	[de]0.6	[de]293	5×(Pure)[i]10^{-6}-(Sweet)[i]$10^{-3\pm1}$-(Sea)[i]1	<3%(Na+Mg+Ca)
High-Density Polymers	[g]0.33 - [g]0.52	[g]296	[g]10^{-16} - [g]10^{2}	
Glycerol	[e]0.29	[e]293		
Wood, +>=12% water	[h]0.09091 - [a]0.16 - [h]0.21 - [e]0.4	[a]298 - [e]293		[h]Species-Variable
Low-Density Polymers	[g]0.04 - [e]0.16 - [e]0.25 - [g]0.33	[g]296 - [e]293	[g]10^{-17} - [g]10^{0}	
Rubber (92%)	[a]0.16	[a]303	~10^{-13}	
Alcohols OR Oils	[e]0.1 - [e]0.21	[e]293		
Wood, oven-dry	[d]0.04 - [h]0.07692 - [d]0.12 - [h]0.17			[h]Cedar - [h]Hickory
Snow, dry	[d]0.11			
Cork	[d]0.04 - [e]0.07	[e]293		
Fiberglass OR Foam OR Wool	[e]0.03 - [d]0.04 - [e]0.045	[e]293		
Expanded polystyrene	[ad]0.033 - ([g](PS Only)0.1 - 0.13)	[a]98-[a]298-[(g)]296	[(g)]<10^{-14} - [(g)]10^{0}	(PS+Air+CO_2+C_nH_{2n+x})
Air	[d]0.024 - [e]0.025 - [a]0.0262	[d]273-[e]293-[a]300		(N+21%O+0.93%Ar+0.04%CO_2) (1 atm)
Oxygen, pure	[d]0.0238 - [i]0.02658	[d]293 - [i]300		(O_2) (1 atm)

Nitrogen, pure	[d]0.0234 - [i]0.02583 - [a]0.026	[d]293 - [ai]300		(N_2) (1 atm)
Silica Aerogel	[a]0.003	[a]98 - [a]298		Foamed Glass
Material	**Thermal conductivity** **$(W \cdot m^{-1} \cdot K^{-1})$**	**Temperature** **(K)**	**Electrical conductivity @ 293 - 273 K** **$(\Omega^{-1} \cdot m^{-1})$**	**Notes**

References

- [a] CRC handbook of chemistry and physics (http://www.hbcpnetbase.com/) (subscription is required to access the data)
- [b] Marble Institute (http://www.marble-institute.com/industryresources/rvalue.cfm)
- [c] Soil Sci Journals (http://soil.scijournals.org/cgi/content/figsonly/64/4/1285)
- [d] Georgia State University - Hyperphysics (http://hyperphysics.phy-astr.gsu.edu/hbase/tables/thrcn.html)
- [e] Hukseflux Thermal Sensors (http://www.hukseflux.com/thermal%20conductivity/thermal.htm)
- [f] Engineers Edge (http://www.engineersedge.com/properties_of_metals.htm)
- [g] GoodFellow (http://www.goodfellow.com/)
- [h] Physical Properties and Moisture Relations of Wood (http://www.fpl.fs.fed.us/documnts/fplgtr/fplgtr113/ch03.pdf)

Note:As the above Wikipedia reference may not cite this table, pure elements are sourced from Chemical elements data references, otherwise an in-table linked-page must list the relevant references.

Heat Conduction Calculator (http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/heatcond.html#c1)

Thermal conductivity of air as a function of temperature can be found at James Ierardi's Fire Protection Engineering Site (http://users.wpi.edu/~ierardi/PDF/air_k_plot.PDF)

See also

- Thermal conductivity
- Thermal conductivities of the elements (data page)

Retrieved from "http://en.wikipedia.org/wiki/List_of_thermal_conductivities"

Categories: Wikipedia list cleanup | Chemical properties | Physical quantity | Thermodynamics | Heat conduction | Technology-related lists

前回の引例

Bismuth

'rom Wikipedia, the free encyclopedia

Bismuth (IPA: ['bɪzməθ]) is a chemical element that has he symbol Bi and atomic number 83. This heavy, brittle, white crystalline trivalent poor metal has a pink tinge and chemically resembles arsenic and antimony. Of all the netals, it is the most naturally diamagnetic, and only nercury has a lower thermal conductivity.

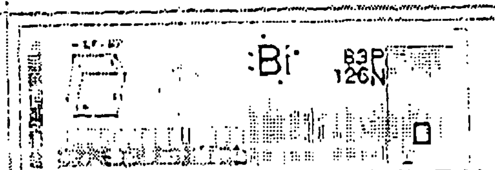
3ismuth compounds are used in cosmetics and in medical procedures. As the toxicity of lead has become more apparent in recent years, alloy uses for bismuth metal as a replacement for lead have become an increasing part of bismuth's commercial importance.

Contents

Notable characteristics

It is a brittle metal with a pinkish hue, often occurring in its native form with an iridescent oxide tarnish showing many refractive colors from yellow to blue. Among the heavy metals, bismuth is unusual in that its toxicity is much lower than that of its neighbors in the periodic table such as lead, thallium, and antimony. No other metal is more naturally diamagnetic (as opposed to superdiamagnetic) than bismuth, and it has a high electrical resistance. Of any metal, it has the second lowest thermal conductivity and the highest Hall effect. When deposited in sufficiently thin layers on a substrate, bismuth is a semiconductor, rather than a poor metal.[1] When combusted with oxygen, bismuth burns with a blue flame and its oxide forms yellow fumes.

While bismuth was traditionally regarded as the element with the heaviest stable isotope, it had long been thought to be unstable on theoretical grounds. Not until 2003 was this demonstrated when researchers at the Institut d'Astrophysique Spatiale in Orsay, France, measured the

83	lead ← bismuth → polonium
Sb ↑ **Bi** ↓ Uup	 Periodic Table - Extended Periodic Table

General	
Name, Symbol, Number	bismuth, Bi, 83
Chemical series	poor metals
Group, Period, Block	15, 6, p
Appearance	lustrous reddish white 
Atomic mass	208.98040(1) g·mol^{-1}
Electron configuration	[Xe] $4f^{14}$ $5d^{10}$ $6s^2$ $6p^3$
Electrons per shell	2, 8, 18, 32, 18, 5
Physical properties	
Phase	solid
Density (near r.t.)	9.78 g·cm^{-3}
Liquid density at m.p.	10.05 g·cm^{-3}
Melting point	544.7 K (271.5 °C, 520.7 °F)
Boiling point	1837 K (1564 °C, 2847 °F)
Heat of fusion	11.30 kJ·mol^{-1}
Heat of vaporization	151 kJ·mol^{-1}
Heat capacity	(25 °C) 25.52 J·mol^{-1}·K

Vapor pressure

P(Pa)	1	10	100	1 k	10 k	100
at T(K)	941	1041	1165	1325	1538	183

Atomic properties	
Crystal structure	rhombohedral
Oxidation states	3, 5 (mildly acidic oxide)

alpha-emission half-life of ^{209}Bi to be 19 x 10^{18} years,[2] meaning that bismuth is very slightly radioactive, with a half-life over a billion times longer than the current estimated age of the universe. Due to its extraordinarily long half-life, for nearly all applications bismuth can be treated as if it is stable and non-radioactive. However, the radioactivity is of academic interest because bismuth is one of few elements whose radioactivity was suspected, and indeed theoretically predicted, before being detected in the laboratory.

Elemental bismuth is one of very few substances of which the liquid phase is denser than its solid phase; most substances have the opposite characteristics (i.e., they expand when they melt). Another well-known example of a substance that expands when it solidifies is water. Because bismuth expands on freezing, it was long an important component of low-melting typesetting alloys which needed to expand to fill printing molds.

Electronegativity	2.02 (Pauling scale)
Ionization energies (more)	1st: 703 kJ·mol^{-1}
	2nd: 1610 kJ·mol^{-1}
	3rd: 2466 kJ·mol^{-1}
Atomic radius	160 pm
Atomic radius (calc.)	143 pm
Covalent radius	146 pm
Miscellaneous	
Magnetic ordering	diamagnetic
Electrical resistivity	(20 °C) 1.29 µ Ω·m
Thermal conductivity	(300 K) 7.97 W·m^{-1}·K^{-1}
Thermal expansion	(25 °C) 13.4 µm·m^{-1}·K^{-1}
Speed of sound (thin rod)	(20 °C) 1790 m/s
Young's modulus	32 GPa
Shear modulus	12 GPa
Bulk modulus	31 GPa
Poisson ratio	0.33
Mohs hardness	2.25
Brinell hardness	94.2 MPa
CAS registry number	7440-69-9
Selected isotopes	

Main article: Isotopes of bismuth

iso	NA	half-life	DM	DE (MeV)	DP
^{207}Bi	syn	31.55 y	ε, β^+	2.399	^{207}P
^{208}Bi	syn	3,368,000 y	ε, β^+	2.880	^{208}P
^{209}Bi	100%	$(19 \pm 2) \times 10^{18}$ y	α		^{205}T

References

Crystals

Though virtually unseen in nature, high-purity bismuth can form into distinctive hopper crystals. These colorful laboratory creations are typically sold to collectors. Bismuth is relatively nontoxic and has a low melting point. Crystals can be grown using a household stove, but this carries significant risk of burns and should not generally be attempted without extensive metal-smelting experience. The resulting crystals will tend to be disappointing when compared to lab-grown crystals.

History

Bismuth (New Latin *bisemutum* from German *Wismuth*, perhaps from *weiße Masse*, "white mass") was confused in early times with tin and lead due to its resemblance to those elements. Basilius Valentinus described some of its uses in 1450. Claude François Geoffroy showed in 1753 that this metal is distinct from lead.

Artificial bismuth was commonly used in place of the actual mineral. It was made by hammering tin into thin plates, and cementing them by a mixture of white tartar, saltpeter, and arsenic, stratified in a crucible over an open fire.[3]

Bismuth was also known to the Incas and used (along with the usual copper and tin) in a special bronze alloy for knives, [2] (http://adsabs.harvard.edu/abs/1984Sci...223..585G)

Occurrence

In the Earth's crust, bismuth is about twice as abundant as gold. It is not usually economical to mine it as a primary product. Rather, it is usually produced as a byproduct of the processing of other metal ores, especially lead, but also

ungsten or other metal alloys.

The most important ores of bismuth are bismuthinite and bismite. The People's Republic of China is the world's larges producer of bismuth, followed by Mexico and Peru. Canada, Bolivia, and Kazakhstan are smaller producers.

The average price for bismuth in 2000 was US$ 7.70 per kilogram. It is relatively cheap, since like lead (but to a much esser extent), it is radiogenic, being formed from the natural decay of uranium and thorium (specifically, by way of neptunium-237 or uranium-233).

Applications

Bismuth oxychloride is sometimes used in cosmetics. Also bismuth subnitrate and bismuth subcarbonate are used in medicine. Bismuth subsalicylate (the active ingredient in Pepto-Bismol) is used as an antidiarrheal and to treat some other gastro-intestinal diseases. Also, bismuth subgallate (the active ingredient in Devrom) is used as an internal deodorant to treat malodor from flatulence (or gas) and stool.

Some other current uses are:

- Strong permanent magnets can be made from the alloy bismanol (BiMn).
- Many bismuth alloys have low melting points and are widely used for fire detection and suppression system safety devices.
- Bismuth is used as an alloying agent in production of malleable irons.
- Bismuth is finding use as a catalyst for making acrylic fibers.
- A carrier for U-235 or U-233 fuel in nuclear reactors.
- Bismuth has also been used in solders. The fact that bismuth and many of its alloys expand slightly when they solidify make them ideal for this purpose.
- Bismuth subnitrate is a component of glazes that produces an iridescent luster finish.
- Bismuth telluride is an excellent thermoelectric material; it is widely used.
- As a replacement propellant for xenon in Hall effect thrusters.
- In 1997 an antibody conjugate with Bi-213, which has a 45 minute half-life, and decays with the emission of an alpha-particle, was used to treat patients with leukemia.

In the early 1990s, research began to evaluate bismuth as a nontoxic replacement for lead in various applications:

- As noted above, bismuth has been used in solders; its low toxicity will be especially important for solders to be used in food processing equipment and copper water pipes.
- As a pigment in artist's oil paint
- As an ingredient of Ceramic glazes
- As an ingredient in free-machining brasses for plumbing applications
- As an ingredient in free-cutting steels for precision machining properties
- As a catalyst for making acrylic fibres
- In low-melting alloys used in fire detection and extinguishing systems
- As an ingredient in lubricating greases
- As a dense material for fishing sinkers.
- As the oxide, carbonate, or subnitrate in crackling microstars (dragon's eggs) in pyrotechnics.
- As a replacement for lead in shot and bullets. The UK, U.S., and many other countries now prohibit the use of lead shot for the hunting of wetland birds, as many birds are prone to lead poisoning due to mistaken ingestion of lead (instead of small stones and grit) to aid digestion. Bismuth-tin alloy shot is one alternative that provides similar ballistic performance to lead (another less expensive but also poorer-performing alternative is steel shot (which is actually soft iron)).

  Bismuth core bullets are also starting to appear for use in indoor shooting ranges, where particles of lead from the bullet impacting the backstop can be a problem. Due to bismuth's crystalline nature, the bismuth bullets

shatter into a non-toxic powder on impact, making recovery and recycling easy. The lack of malleability does, however, make bismuth unsuitable for use in expanding hunting bullets.

- FN Herstal uses bismuth in the projectiles for their FN 303 less-lethal riot gun.

See also

- Bismuth compounds
- Bismuth minerals

References

1. ^ Semimetal-to-semiconductor transition in bismuth thin films, C. A. Hoffman, J. R. Meyer, and F. J. Bartoli, A. Di Venere, X. J. Yi, C. L. Hou, H. C. Wang, J. B. Ketterson, and G. K. Wong, Phys. Rev. B 48, 11431 (1993) DOI:10.1103/PhysRevB.48.11431 (http://dx.doi.org/10.1103/PhysRevB.48.11431)
2. ^ Marcillac, Pierre de; Noël Coron, Gérard Dambier, Jacques Leblanc, and Jean-Pierre Moalic (April 2003). "Experimental detection of α-particles from the radioactive decay of natural bismuth". *Nature* 422: 876–878. DOI:10.1038/nature01541 (http://dx.doi.org/10.1038/nature01541).
3. ^ *This article incorporates content from the 1728* Cyclopaedia, *a publication in the public domain.* [1] (http://digicoll.library.wisc.edu/cgi-bin/HistSciTech/HistSciTech-idx?type=turn&entity=HistSciTech000900240255&isize=L)

External links

- WebElements.com - Bismuth (http://www.webelements.com/webelements/elements/text/Bi/index.html)
- "Bismuth Statistics and Information (http://minerals.usgs.gov/minerals/pubs/commodity/bismuth/)" - United States Geological Survey minerals information for bismuth
- Bismuth breaks half-life record for alpha decay (http://physicsweb.org/article/news/7/4/16)
- Los Alamos National Laboratory - Bismuth (http://periodic.lanl.gov/elements/83.html)

Retrieved from "http://en.wikipedia.org/wiki/Bismuth"

Categories: Cyclopaedia | Bismuth | Chemical elements | Alchemical substances